Application No. 10/611,743
Amendment dated July 17, 2006
Reply to Office Action Dated April 17, 2006

REMARKS/ARGUMENTS

In the Office Action dated April 17, 2006, the Examiner rejected claims 2-24, all of the claims pending in the application, and made the action Final.

In view of the Final action by the Examiner, Applicants have canceled claims 2, 3, 6, 16, and 17, with claim 1 being earlier canceled in Amendment C and has amended the now remaining independent claims, claims 4, 18 and 22 by incorporating in the preamble, in addition to the already existing limitation of Applicants' type of inorganic membrane (i.e., one selected from the group consisting of metal oxides, metal nitrides and metal carbides) an initial pore size radius limitation of at least 18.5 Å for Applicants' ceramic inorganic membrane. Support for the pore size addition in the independent claim preamble is found in Example 1.

It is submitted that Applicants' claims, as now amended, contain limitations in the preamble that give life and meaning to the claims and are essential to point out Applicants' invention and distinguish the claims over the prior art of record. Accordingly, it is submitted that the Examiner has, and continues through the present Office Action, ignored the preamble limitations that Applicants have pointed out in previous Responses and herein in this Response that patentably distinguish their claims over the prior art of record. The courts have held that preamble limitations of this kind must be considered by the PTO.

Claims 4-5, 7-15, and 20-24 remain in this application.

Applicants' respectfully request that the Examiner reconsider his final rejection of Applicants' invention, as now claimed, under the rejections of the previous Office Action under 35 U.S.C. 103(a) as being unpatentable over Funke et al. in view of Butler et al. and either Funke et al. in view of Levy et al. and now maintained in the present Office Action in light of the presently amended claims, the submitted arguments and in particular the earlier submitted Declaration of Dr. Roddy Judkins. The purpose of this amendment after final is to place the present application, containing the now amended claims, in condition for allowance or in better form for appeal.

The Examiner in his Response to Arguments notes Applicants' argument and signed Declaration that it would not have been obvious to use a metal oxide as the membrane. He concludes this is not found convincing, noting that Funke et al. is explicitly open to other materials besides zeolites comprising the membrane (column 5, line 55-65) and Butler et al. teaches the art recognized suitability of using metal oxide as the membrane. Thus, it would have been an obvious benefit to use metal oxide.

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Insofar as this rejection of obviousness is maintained in the rejection of claims 2-24 under 35 U.S.C. 103(a), it is respectfully traversed. While it is well recognized that metal oxides have industrial applications, it is urged that neither Funke et al. nor Butler et al. teach or hint that the metal oxide membranes have surface hydroxyl groups, as Applicants have taught. The Examiner is invited to point out in either of these prior art patents where this teaching is found. Funke et al. does not teach that metal oxide membranes have surface hydroxyls because they do not show metal oxides as the Examiner acknowledged; Butler et al. shows metal oxides as membranes but does not teach or hint that metal oxide membranes have surface hydroxyls. Given this lack of disclosure it can hardly be correctly concluded that it would have been an obvious benefit to use metal oxide in Applicants' process.

It is clear under the court cases that provide guidance in the PTO 103(a) obviousness rejection that the prior art reference or combination of references must teach or suggest all of the limitations of the claims and the teaching or suggestion, as well as the expectation of success, must come from the prior art, not Applicants' disclosure.

Absent a teaching of this critical feature of the claimed invention, Funke et al. alone or in combination with Butler et al. fail to teach all of the limitations of the claims including the preamble limitations as now amended and it is submitted that the PTO has not met its initial burden of establishing a *prima facie* case of obviousness against Applicants' claims and the rejection must be withdrawn.

Additionally, the Examiner in his Response to Arguments found not convincing Applicants' arguments and the signed Declaration submitted in Amendment C that the coating of Funke et al. is not deposited on the pore walls of membrane and if found would clog the pores. He notes with respect to Funke et al. that (1) the object is to reduce the diameters of the pores of the membrane, (2) the larger pores allow larger molecules to enter and even teaches that some of the larger pores may be clogged by the coating (column 6, lines 33-64), and (3) the reference shows that the coating enters the walls of the gaps formed between crystals (figure 1) and any pore large enough to allow the passage of the reactant would also receive some coating within the walls of the pore, which are the naturally occurring pores (defects) that Funke et al. is concerned with eliminating or reducing the diameter of. While stating his agreement that for the most part, the coating may be contained on the surface of the membrane, he concludes, however, that at least some coating material would inherently be deposited on the walls of the pores, even if only at a small penetration depths, in the pores large enough to allow passage of the reactants, which would be sufficient for reading on the claims.

It is to be noted that it is not clear the Examiner's intention in this section of the Office Action as to whether by concluding that it would "be sufficient for reading on the claims" he is giving a rejection of the claims based on 35 U.S.C. 102(e) which was given in an

earlier Office Action but not continued in the previous one dated October 4, 2005. Later in the section "Claim Rejections -35 USC §103" where he states that the rejections of the previous Office Action have been maintained and are duplicated below, the rejection of record relates only to rejections of the claims based on 35 U.S.C. § 103.

Therefore, to the extent there is a rejection of the claims under 35 U.S.C. 102(e) based on the Funke et al. patent that rejection is also respectfully traversed. As earlier argued, the PTO and courts have required for §102(e) anticipation that a single reference must teach (i.e., identically describe) each and every material element or step of the rejected claim. It is submitted that such a rejection of Applicants' claimed invention, as now amended, to include additional preamble language that includes limitations on pore size, matrix material of metal oxides, metal nitrides, and metal carbides, and the deposition of the at least one monolayer of the selected inorganic compound within (i.e., on the surface of the pore walls) matrix of material particles which make up the ceramic inorganic membrane, fails to satisfy this requirement.

Further, as noted in their earlier response, Applicants believe that the Examiner continues to misconstrue the clear teachings and disclosure of Funke et al. in his assertion that Funke et al. is concerned with depositing the monolayers on the surface of the pore walls of their zeolite or molecular sieve membranes, i.e., *within the pore channels* that are defined by the crystallographic structure of the zeolite crystals (emphasis added). Applicants continue to believe that this assertion by the Examiner is not correct.

It is believed instructive to understand that Funke et al. teaches and shows for their zeolite membrane structures three different structural features: 1) various pore channels 26 (see column 6, lines 35-36), which are openings defined by the crystallographic structure and which define the critical diameter of the membrane for purposes of functioning as a molecular sieve whereby small molecules can enter and pass, (2) defects in individual crystals that are occur from the synthesis process of making the crystalline membrane, and (3) microscopic gaps that are formed between the individual crystals also formed in the synthesis process of making the crystalline membrane. The latter two can and do provide conduits through which larger molecules can pass and limit the zeolites usefulness as molecular sieves. The pore channels or pores are inherently formed in the synthesis process of the porous crystalline membrane materials and are characterized by dimensions of molecular dimensions, e.g., around 5.4 Å and need no further trimming to function as a molecular sieve.

In contradistinction thereto, Applicants achieve the reduction of the pore size of its metal oxide membranes, which have an initial pore radius of about 18.5 Å, by conducting successive cycles of depositing one monolayer at a time uniformly within the pores or interstices between the particles of the metal oxide that make up the matrix of the metal

oxide membrane to reduce the mean pore radius to about 2.5 Å, which required at least four cycles to achieve this extremely small molecular sieving pore size.

As noted before, it is submitted that Funke et al. is not concerned with and does not show depositing the monolayers on the surface of the walls of the zeolite or molecular sieve membrane, i.e., within the pore channels 26 in the lattice crystals 12; rather, they are concerned with sealing the gaps or defects between the individual crystals which can be larger than the pore sizes in the crystalline structures by forming one or more layers on the surfaces of the crystals which layers are porous enough to allow entry and passage of smaller molecules through the crystal lattice (i.e., pore channels 26).

This is further supported in the submitted Declaration where Dr. Judkins rebutted this erroneous conclusion by the Examiner (see page 3, last bullet). There, Dr. Judkins concluded that while Funke et al. does teach that their process can also decrease the effective size of the diameter of the pores the reduction is effectuated by reducing the diameter of the pore openings (not the internal diameter of the pores by the layer 20 covering the top and exposed surfaces. He noted that his conclusion is further supported at Column 9, lines 27-34, where there is discussed that one monomolecular layer deposited according to their invention is "formed around or over the pore openings 24 in the crystals." He concluded that there is no mention or showing in the drawings of the monomolecular layer being deposited within the pores of the membrane.

Moreover, the presence of these defects and microscopic gaps which are inherent in the manufacturing process of these particular types of materials is precisely the prior art problem that Funke et al. addressed, not trimming the pore channels, which are already of a molecular dimension and need no reduction in their diameter. Applicants, on the other hand, solved a different prior art problem of how to reduce the pore size of ceramic inorganic membranes, such as an alumina membranes, which the smallest commercially available pore size is about 40 Å, to a molecular dimension, e.g., about 5 Å, thereby making a fundamentally different class of inorganic membranes, such as metal oxides, useful as molecular sieves. In this way, it should be seen that Applicants' metal oxide membranes do not merely "possess some of the defects, but not all, that Funke et al. is concerned with overcoming."

Additionally, this critical point of distinction between the Funke et al. zeolite or similar microporous crystalline molecular sieves, i.e., ALOPO, SAPO, or MCM41 (see column 5, lines 55-60), and Applicants' metal oxide membrane is set forth as a limitation in the preamble of Applicants' independent claims 4, 18 and 22, as further amended in this Response.

As presently claimed, each of Applicants' independent method claims contain a limitation: "an initial mean pore radius of at least about 18.5 Å and having a matrix of

material particles of an inorganic compound selected from the group consisting of metal oxides, metal nitrides, and metal carbides, which make up the pore walls of the pores of said matrix comprising ...." It is urged that these limitations in the preamble give life and meaning to the claims and are essential to point out Applicants' invention and distinguish the claims over the prior art and must be considered in determining patentability of the instant claims.

The courts dealt with the question of when a preamble limits the body of the claim in *Kropa v. Robie*, 187 F2d, 150, 88 USPQ 478 (C.C.P.A. 1951) where:

> If the preamble merely state a purpose or intended use and the remainder of the claim completely defines the invention independent of the preamble, it is not a limitation on the claim. On the other hand, if the claim cannot be read independently of the preamble and the preamble must be read to give meaning to the claim or is essential to point our the invention, it constitutes a limitation upon the claim.

Similarly, in *In re Bulloch*, 604 f2d 1362, 203 U.S.P.Q. 171 (C.C.P.A. 1979) the court considered whether the preamble is essential to point out the invention defined by the claims and citing the *Kropa* case the court held that the "introductory claim language ... is more than a mere statement of purpose; and that language is essential to point out the invention defined by the claims."

Accordingly, it is submitted that while the Examiner has, and continues through the present Office Action, ignored the preamble limitations that Applicants have pointed out in previous Responses and herein in this Response that patentably distinguishes their claims over the prior art of record, the preamble limitations are material to the issue of patentability and should be duly considered and observed. It is respectfully requested that the rejection under 35 U.S.C. 102(e) based on the Funke et al. patent, to the extent it was intended by the Examiner to be included in the present Office Action, be withdrawn as it was done previously.

Claims 2-24 were rejected by the Examiner under 35 U.S.C. §103(a) as being unpatentable over Funke et al. (US 6,501,517) in view of Butler et al. (US 4,938,870)

The Examiner states that Funke et al. teaches the claimed process at Col. 4, lines 20-50, Col. 4, lines 60-68, Col. 7, lines 10-15, 25-30, and 60-65, Col. 8, lines 30-45, Col. 9, lines 1-3 and 35-50, Col. 10, lines 21-55 and Col. 11, lines 34-38. He further notes that the pore sizes disclosed in the examples after deposition of the layers are in the claimed ranges. He further states that Funke et al. teaches that the membrane may be zeolite or any other inorganic crystalline membrane that has surface hydroxyl groups. He notes that while Funke et al. is silent in teaching that the membrane is a metal oxide, Butler et al.

teaches that porous metal oxide membranes are known in the art to have industrial application. From this, he concludes that it would have been obvious at the time the invention was made to a person having ordinary skill in the art to use metal oxide as the ceramic membrane material in Funke et al.. And by doing so, one would have a reasonable expectation of success, as Funke et al. explicitly teaches the art recognized suitability of using other ceramic membranes and Butler et al. teach the industrial applicability of metal oxide membranes.

This rejection is respectfully traversed. While it is well recognized that metal oxides have industrial applications, it is urged that neither Funke et al. nor Butler et al. teach or hint that the metal oxide membranes have surface hydroxyl groups, as Applicants have taught. As noted before, Funke et al. does not teach that metal oxide membranes have surface hydroxyls because they do not show metal oxides as the Examiner acknowledged; Butler et al. shows metal oxides as membranes but does not teach or hint that metal oxide membranes have surface hydroxyls.

It is clear under the court cases that provide guidance in the PTO 103(a) obviousness rejection that the prior art reference or combination of references must teach or suggest all of the limitations of the claims and the teaching or suggestion, as well as the expectation of success, must come from the prior art, not Applicants' disclosure.

Absent a teaching of this critical feature of the invention, as now claimed, the Examiner's conclusion that it would have been obvious at the time the invention was made to a person having ordinary skill in the art to use metal oxide as the ceramic membrane in Funke et al. is without merit. It is submitted that under the above-noted court cases guidance to the PTO in 103(a) obviousness rejection the expectation of success must come from the prior art, not Applicants' disclosure. This teaching is not found in either of the cited prior art patents and hence one skilled in the art viewing the disclosure in either Funke et al. or Butler et al. would not any reason to use the metal oxide as the ceramic membrane in Funke et al. with any reasonable expectation of success as suggested by the Examiner.

Further, while Funke et al. does teach that other crystalline membranes or molecular sieve materials having surface hydroxyl groups or other reactive groups, such as NH_2 and SH_2, can also be accomplished according to this invention, such teaching must be viewed from what is enabled by the Specifications, Drawings and the Claims. Accordingly, the Examiner's assertion that Funke et al. teaches the art recognized suitability of using other ceramic membranes and when coupled with Butler et al. teaching the industrial applicability of metal oxide membranes, one would have a reasonable expectation of success with metal oxides as the membrane is believed to be an unwarrant in view of the lack of any enabling disclosure for the asserted breath that the Examiner has attempted to extend their disclosure to, namely, metal oxides.

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That this is true may be seen from a careful review of the Funke et al. Specification and Drawings. The Funke et al. patent from its title ("Modified Zeolite Membrane"); to its specification, see column 5, lines 55-65, which sets forth the membrane materials as crystalline substances of zeolites and molecular sieves of ALPO's, SAPO's and MCM41, all being characterized by pores of molecular dimensions and uniform size (i.e. <10 Å); to its examples which are all limited to zeolites and in particular to silicalite (zeolites), to its claims which recite a membrane or molecular sieve membrane containing SiO_2 values is limited in its enabling disclosure to a narrow class of molecular sieves that are zeolites or crystalline structures that are structurally similar to the zeolites, i.e., other molecular sieve materials of ALPO's, SAPO's and MCM41. It is submitted that there is no enabling disclosure for the extension to fundamentally different membrane structures, such as metal oxides.

As noted in Applicants' previous Response, Butler et al. teaches a process for preparing a composite sheet of a porous inorganic membrane, such as alumina, and a microporous inorganic film, such as gamma-alumina, overlaying a surface of the membrane with the average pore size of the microporous film being from 0.5 to 30 nm or 5.0 to 300 Angstroms. The inorganic film may be formed by applying a colloidal sol, which does not penetrate into the pores of the membrane, of an inorganic material to the membrane and subsequently drying by heating to form the composite ultrafiltration membrane.

Neither Funke et al. alone or in combination with Butler et al. teach or suggest Applicants' invention as now amended and it is submitted that neither can, in the absence of any teaching or suggestion that metal oxide membranes have surface hydroxyls, provide any expectation of success of a method as now claimed by Applicants. Applicants achieve the reduction of the pore size of its metal oxide membranes, which have an initial pore radius of about 18.5 Å, by conducting successive cycles of depositing one monolayer at a time uniformly within the pores or interstices between the particles of the metal oxide that make up the matrix of the metal oxide membrane to reduce the mean pore radius to about 2.5 Å, which required at least four cycles to achieve this extremely small molecular sieving pore size.

Accordingly, the rejection of Claims 2-24 under 35 U.S.C. §103(a) as being unpatentable over Funke et al. alone or in view of Butler et al. must be withdrawn.

The Examiner also rejected claims 14 and 15, noting that Funke et al. teaches the limitations of claim 4 but does not explicitly disclose coating only one side of the membrane, such as by placing the membrane on a holder. He notes that because the purpose of the membranes disclosed in the above references is to filter material, which involves passing a medium through the membrane to allow some material to pass through based on the adjusted pore size and such passing through is only usually performed from

a single direction through the filter to avoid dislodging trapped material filtered out by the membrane, it would have been obvious to coat only the inflow side of the filter to adjust the pore size thereof because that is the side at which filtration is performed and coating only one side would have the clear advantages of saving process time and cost by coating only one side as opposed to both sides.

This rejection is respectfully traversed. It is to be noted that claim 14, as now amended, is a dependent claim, depending from now independent claim 4 and claim 15 is a dependent claim from claim 14. As such these claims incorporate all of the limitations found now in independent claim 4.

It is submitted for the reasons given above that the Examiner is in error when he asserts that Funke et al. teaches the limitations of claim 4 as now amended. He is correct when he states that Funke et al. does not explicitly disclose coating only one side of the membrane, such as by placing the membrane on a holder.

However, as noted above, the method disclosed in Funke et al. coats all surfaces of the zeolite crystals, i.e., on the top, side and bottom or other surface (gap or region between the juxtaposed faces of adjacent faces of the zeolite crystals). (See Figs.1 and 5 and text at Col. 6, lines 13-19 and lines 35-40). It is submitted that the method disclosed in the Funke et al. patent inherently coats all surfaces to modify the zeolite or other crystalline molecular sieves and therefore the requisite finding in the Funke et al. reference of a suggestion, incentive, or a reasonable expectation to coat only a single side of the membrane as found in the rejected claims is not found.

Absent a finding of the above-discussed three requisites, all of which must come from the Funke et al., it is submitted that the PTO has not established a *prima facie* case of obviousness and the rejection of claims 14 and 15 under 35 U.S.C. 103(a) on the Funke et al. reference must be withdrawn.

Lastly, the Examiner rejected claims 2-24 under 35 U.S.C. 103(a) as being unpatentable over either Funke et al. in view of Levy et al.

The Examiner stated that Funke et al. teaches the limitations noted above in his Office action but does not explicitly disclose a gamma alumina or alumina membrane. However, because Levy et al. discloses that it is desirable to decrease the pore size of alumina membranes by depositing inorganic compounds thereon (Col. 7, line 23), it would have been obvious to have coated an alumina membrane by the process of Funke et al. with a reasonable expectation that doing so would successfully provide an alumina membrane having an adjusted pore size to tailor its filtration properties.

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This rejection is respectfully traversed. While Levy et al. discloses that it is desirable to decrease the pore size of alumina membranes, he does it by a counterflow gas method with a at least two reactant gas streams to deposit via a low pressure chemical vapor deposition technique microporous film predominately of silicon doxide and optionally polysilicon, silicon carbide or silicon nitride within the walls of a mesoporous membrane substrate, such as alumina. The Levy et al. patent does not teach or recognize that the alumina has surface hydroxyl groups, as disclosed by Applicants.

As noted herein above, Funke et al. does not teach that metal oxide membranes have surface hydroxyls because they do not disclose a gamma or alumina membrane as the Examiner acknowledged. The absence of this critical teaching is believed to be fatal to a finding by the Examiner that it would have been obvious to have coated an alumina membrane by the process of Funke et al. with a reasonable expectation that doing so would have successfully provided and alumina membrane having an adjusted pore size to tailor its filtration properties. A careful review of the Funke et al. patent finds that it is devoid of any suggestion or incentive that would have motivated one to modify or combine references, as suggested by the Examiner, to utilize their process, which is limited to modifying zeolite or crystalline molecular sieve membranes, to coat a different type of membrane, i.e., an alumina membrane, especially in the absence of any teaching that alumina membranes have surface hydroxyls.

Clearly, the Funke et al. patent does not teach or suggest all of the limitations of rejected claims 2-24, as now amended. Given this lack of disclosure of any suggestion or motivation to modify their process, it is submitted that the Examiner's assertion that such a modification to the contrary would be met with a reasonable expectation of success in reducing the pore size of a gamma or alumina membrane by Applicants' claimed process is equally without merit.

The PTO has the burden under a §103 obvious rejection to establish a *prima* facie case. As part of the three-prong test, the Examiner has an initial burden to satisfy the requirement that the prior art relied upon must contain some suggestion or incentive that would motivate the skilled artisan to modify or combine the references. It is submitted that no suggestion or incentive is found in either Funke et al. or when combined with Levy et al.

Absent a such a finding, all of which must come from the Funke et al. in view of Levy et al. reference, it is submitted that the PTO has not established a *prima facie* case of obviousness rejection under 35 U.S.C. 103(a) with respect to claims 2-24. It is therefore respectfully requested that the rejection on the Funke et al. alone or in combination with Levy et al. references must be withdrawn.

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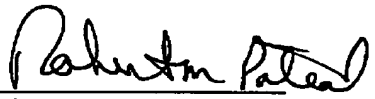
In view of the above remarks, the submitted Declaration under 1-1.32, it is submitted that the amendments to the remaining claims puts the present application in condition for allowance or for appeal.

Respectfully submitted,



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